

WHAT IS CLAIMED IS:

1. A system for accomplishing localized feature forming or localized joining in one or more sheets of material, comprising:

a die having a cavity for imparting a shaped feature to said one or more sheets of material;

a projectile firing device in substantial alignment with said cavity, said projectile firing device for propelling a projectile into said one or more sheets of material;

a projectile adapted to be propelled from said projectile firing device into said one or more sheets of material, said projectile for forcing at least a portion of said one or more sheets of material into said cavity to impart said shape thereto.

2. The system of claim 1, wherein said one or more sheets of material are metallic.
3. The system of claim 1, wherein said projectile is deformable.
4. The system of claim 1, wherein said projectile is comprised of a metallic material.
5. The system of claim 1, wherein said projectile is comprised of plastic.
6. The system of claim 1, wherein said projectile is comprised of a liquid.
7. The system of claim 1, wherein said projectile is comprised of ice.
8. The system of claim 1, wherein said projectile is of substantially the same shape as said cavity.
9. The system of claim 1, wherein said projectile firing device employs compressed gas to propel said projectile.

10. The system of claim 1, wherein said projectile firing device employs an explosive charge to propel said projectile.

11. The system of claim 1, wherein said projectile firing device employs an electrical charge to propel said projectile.

12. The system of claim 1, further comprising an enclosure that encapsulates at least a portion of said projectile firing device and said area of said one or more sheets of material that will be impacted by said projectile.

13. The system of claim 1, further comprising a means for securing the position of said one or more sheets of material during the impact of said projectile.

14. The system of claim 13, wherein said securing means is a vacuum.

15. The system of claim 13, wherein said securing means is magnetic.

16. The system of claim 1, wherein multiple sheets of material are used.

17. The system of claim 16, wherein said multiple sheets are joined via an interlocking shape produced by the forcing at least a portion of said multiple sheets of material into said cavity by said projectile.

18. The system of claim 16, wherein said multiple sheets are joined via a metallurgical bond produced therebetween by the forcing at least a portion of said multiple sheets of material into said cavity by said projectile.

19. The system of claim 16, wherein said multiple sheets are joined via both an interlocking shape and a metallurgical bond produced therebetween by the forcing of at least a portion of said multiple sheets of material into said cavity by said projectile.

20. The system of claim 1, wherein the velocity of said projectile is between about 50 and about 2,000 feet per second at the time it contacts said one or more sheets of material.

21. The system of claim 1, further comprising a means for releasably securing a secondary component within said die cavity, said secondary component adapted for attachment to said one or more sheets of material by the impact of said projectile.

22. A method for accomplishing the localized feature forming or localized joining of one or more sheets of material, comprising:

providing a die having a cavity for imparting a shaped feature to said one or more sheets of material;

providing a projectile for contacting said one or more sheets of material at a point that is in substantial alignment with said cavity;

providing a projectile firing device for propelling said projectile into said one or more sheets of material;

locating said one or more sheets of material between said die cavity and said projectile firing device; and

propelling said projectile into said one or more sheets of material;

whereby said projectile forces at least a portion of said one or more sheets of material into said cavity to impart said shape thereto.

23. The method of claim 22, wherein said one or more sheets of material are metallic.

24. The method of claim 22, wherein said projectile is deformable.

25. The method of claim 22, wherein said projectile is comprised of a metallic material.

26. The method of claim 22, wherein said projectile is comprised of plastic.

27. The method of claim 22, wherein said projectile is comprised of a liquid.

28. The method of claim 22, wherein said projectile is comprised of ice.

29. The method of Figure 22, wherein said projectile is of substantially the same shape as said cavity.
30. The method of claim 22, wherein said projectile firing device employs compressed gas to propel said projectile.
31. The method of claim 22, wherein said projectile firing device employs an explosive charge to propel said projectile.
32. The method of claim 22, wherein said projectile firing device employs an electrical charge to propel said projectile.
33. The method of claim 22, further comprising containing any ricochets of said projectile with a housing that encapsulates at least a portion of said projectile firing device and said area of said one or more sheets of material that will be impacted by said projectile.
34. The method of claim 22, further comprising securing the position of said one or more sheets of material during the impact of said projectile.
35. The method of claim 34, wherein said securing means is a vacuum.
36. The method of claim 34, wherein said securing means is magnetic.
37. The method of claim 22, wherein multiple sheets of material are used.
38. The method of claim 37, wherein said multiple sheets are joined via an interlocking shape produced by the forcing of at least a portion of said multiple sheets of material into said cavity by said projectile.
39. The method of claim 37, wherein said multiple sheets are joined via a metallurgical bond produced therebetween by the forcing of at least a portion of said multiple sheets of material into said cavity by said projectile.

40. The method of claim 37, wherein said multiple sheets are joined via both an interlocking shape and a metallurgical bond produced therebetween by the forcing of at least a portion of said multiple sheets of material into said cavity by said projectile.

41. The method of claim 22, wherein the velocity of said projectile is between about 50 and about 2,000 feet per second at the time it contacts said one or more sheets of material.

42. The method of claim 22, further comprising a means for locating a secondary component within said die cavity, such that said secondary component can be attached to said one or more sheets of material by forcing a portion of said one or more sheets of material through an aperture in said secondary component with said projectile and using said die to thereafter expand said portion of one or more sheets of material protruding through said aperture outwardly beyond the circumference of said aperture.

43. The method of claim 42, wherein said secondary component is a pull tab for a beverage can.

44. The method of claim 42, wherein said secondary component is a pull tab for a food can.

45. The method of claim 22, wherein said one or more sheets of material are comprised of a low-ductility steel.

46. A system for accomplishing localized feature forming in a metallic sheet, comprising:

a die having a cavity for imparting a shaped feature to said metallic sheet, said die adapted to reside near said metallic sheet such that said cavity lies subjacent thereto;

a projectile firing device in substantial alignment with said cavity, said projectile firing device for propelling a projectile at a high velocity into said metallic sheet; and

a deformable projectile adapted to be propelled from said projectile firing device into said metallic sheet at a point that is in substantial alignment with said subjacent cavity, said deformable projectile for forcing at least a portion of said metallic sheet into said cavity to impart said shape thereto.

47. The system of claim 46, wherein said deformable projectile is comprised of a metallic material.

48. The system of claim 46, wherein said deformable projectile is comprised of plastic.

49. The system of claim 46, wherein said deformable projectile is comprised of a liquid.

50. The system of claim 46, wherein said deformable projectile is comprised of ice.

51. The system of claim 46, wherein said projectile is of substantially the same shape as said cavity.

52. The system of claim 46, further comprising a means for securing the position of said one or more metallic sheets during the impact of said deformable projectile.

53. The system of claim 52, wherein said securing means is a vacuum.

54. The system of claim 52, wherein said securing means is magnetic.

55. A system for accomplishing the localized joining of multiple metallic sheets, comprising:

a die having a cavity for creating an interlocking joint in said metallic sheets, said die adapted to reside near said metallic sheets such that said cavity lies subjacent thereto;

a projectile firing device in substantial alignment with said cavity, said projectile firing device for propelling a deformable projectile at a high velocity into said metallic sheets; and

a deformable projectile adapted to be propelled from said projectile firing device into said metallic sheets at a point that is in substantial alignment with said subjacent cavity, said deformable projectile for forcing at least a portion of said metallic sheets into said cavity to form said interlocking joint therein.

56. The system of claim 55, wherein said deformable projectile is comprised of a metallic material.
57. The system of claim 55, wherein said deformable projectile is comprised of plastic.
58. The system of claim 55, wherein said deformable projectile is comprised of a liquid.
59. The system of claim 55, wherein said deformable projectile is comprised of ice.
60. The system of claim 55, further comprising a means for securing the position of said metallic sheets during the impact of said deformable projectile.
61. The system of claim 60, wherein said securing means is a vacuum.
62. The system of claim 60, wherein said securing means is magnetic.

63. The system of claim 55, wherein said projectile firing device propels said deformable projectile at a velocity sufficient to cause a metallurgical bond between a portion of the metallic sheets in said joint.

64. The system of claim 55, wherein said joint has a reentrant shape.

65. A system for accomplishing the localized joining of multiple metallic sheets, comprising:

a die having a cavity for imparting a shaped feature to said metallic sheets, said die adapted to reside near said metallic sheets such that said cavity lies subjacent thereto;

a deformable projectile adapted to be propelled from a projectile firing device into said metallic sheets at a point that is in substantial alignment with said subjacent cavity, said deformable projectile for forcing at least a portion of said metallic sheets into said cavity to impart said shape thereto; and

a projectile firing device in substantial alignment with said cavity, said projectile firing device adapted to propel said deformable projectile into said metallic sheets at a velocity sufficient to cause the plastic deformation and subsequent metallurgical bonding of a portion of said metallic sheets located in said joint.

66. The system of claim 65, wherein said deformable projectile is comprised of a metallic material.

67. The system of claim 65, wherein said deformable projectile is comprised of plastic.

68. The system of claim 65, wherein said deformable projectile is comprised of a liquid.



69. The system of claim 65, wherein said deformable projectile is comprised of ice.

70. The system of claim 65, further comprising a means for securing the position of said metallic sheets during the impact of said deformable projectile.

71. The system of claim 70, wherein said securing means is a vacuum.

72. The system of claim 70, wherein said securing means is magnetic.

73. A method for accomplishing localized feature forming in a metallic sheet, comprising:

providing a die having a cavity for imparting a shaped feature to said metallic sheet, said die adapted to reside near said metallic sheet such that said cavity lies subjacent thereto;

providing a projectile firing device in substantial alignment with said cavity, said projectile firing device for propelling a projectile at a high velocity into said metallic sheet;

providing a deformable projectile adapted to be propelled from said projectile firing device into said metallic sheet at a point that is in substantial alignment with said subjacent cavity, said deformable projectile for forcing at least a portion of said metallic sheet into said cavity to impart said shape thereto;

locating said metallic sheets between said die cavity and said projectile firing device; and

propelling said projectile into said metallic sheet.

74. The method of claim 73, further comprising securing the position of said metallic sheet prior to impact by said deformable projectile.

75. A method for accomplishing the localized joining of multiple metallic sheets, comprising:

providing a die having a cavity for creating an interlocking joint in said metallic sheets, said die adapted to reside near said metallic sheets such that said cavity lies subjacent thereto;

providing a projectile firing device in substantial alignment with said cavity, said projectile firing device for propelling a projectile at a high velocity into said metallic sheets;

providing a deformable projectile adapted to be propelled from said projectile firing device into said metallic sheets at a point that is in substantial alignment with said subjacent cavity, said deformable projectile for forcing at least a portion of said metallic sheets into said cavity to form said interlocking joint therein;

locating said metallic sheets between said die cavity and said projectile firing device; and

propelling said projectile into said metallic sheets.

76. The method of claim 75, further comprising creating a metallurgical bond between a portion of said metallic sheets in said joint by the impact of said projectile.

77. The method of claim 75, further comprising securing the position of said metallic sheets during the impact of said projectile.

78. A method for accomplishing the localized joining of multiple metallic sheets, comprising:

providing a die having a cavity for imparting a shaped feature to said metallic sheets, said die adapted to reside near said metallic sheets such that said cavity lies subjacent thereto;

providing a projectile firing device in substantial alignment with said cavity, said projectile firing device for propelling a projectile at a high velocity into said metallic sheets;

providing a deformable projectile adapted to be propelled from said projectile firing device into said metallic sheets at a point that is in substantial alignment with said subjacent cavity, said deformable projectile for forcing at least a portion of said metallic sheets into said cavity to impart said shape thereto;

locating said metallic sheets between said die cavity and said projectile firing device;

propelling said projectile into said metallic sheets; and

creating a metallurgical bond between a portion of said metallic sheets in said feature

79. The method of claim 78, wherein said shape imparted to said metallic sheets by said cavity is of an interlocking geometry.

80. The method of claim 79, wherein said interlocking shape is a reentrant shape.

81. The method of claim 78, further comprising securing the position of said metallic sheets during the impact of said projectile.

82. A method for attaching a secondary component to a metallic sheet, comprising:

providing a die having a cavity for imparting a shaped feature to said metallic sheet, said die adapted to reside near said metallic sheet such that said cavity lies subjacent thereto;

providing a secondary component for attachment to said metallic sheet, said secondary component having an aperture adapted to receive a portion of said metallic sheet;

providing a means within said die cavity for releasably securing said secondary component;

providing a projectile firing device in substantial alignment with said cavity, said projectile firing device for propelling a projectile at a high velocity into said metallic sheet;

providing a projectile adapted to be propelled from said projectile firing device into said metallic sheet at a point that is in substantial alignment with said aperture in said secondary component;

locating said metallic sheet between said die cavity and said projectile firing device;

propelling said projectile into said metallic sheet;

causing at least a portion of said metallic sheet to be forced through said aperture in said secondary component; and

causing said portion of said metallic sheet that has been forced through said aperture to expand outwardly upon contact with said die cavity, said expansion continuing beyond the circumference of said aperture.

83. A method for attaching one or more metallic sheets to another component, wherein said component has substantially more mass than said metallic sheet , comprising:

providing a receiving shape in said component;

locating said one or more metallic sheets over said receiving shape;

providing a projectile firing device in substantial alignment with said receiving shape, said projectile firing device for propelling a projectile at a high velocity into said one or more metallic sheets;

providing a projectile adapted to be propelled from said projectile firing device into said one or more metallic sheets;

propelling said projectile into said one or more metallic sheets; and

causing at least a portion of said one or more metallic sheets to be forced into said receiving shape.

84. The method of claim 83, wherein said one or more metallic sheets remain attached to said component by means of an interlocking joint formed therebetween.

85. The method of claim 83, wherein said one or more metallic sheets remain attached to said component by means of a metallurgical bond formed between said one or more metallic sheets and said component.

86. The method of claim 83, wherein said one or more metallic sheets remain attached to said component by a combination of an interlocking joint and a metallurgical bond formed between said one or more metallic sheets and said component.

87. The method of claim 83, further comprising securing the position of said one or more metallic sheets prior to the firing of said projectile.